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RUSSIAN CHROME ORE

As a result of continued rises in output since 1926, the U.S.S.R. may now be the world's largest producer of chromite. Between 1927 and 1935, and again since 1944, the U.S.S.R. has been a major exporter of the ore. At the same time, inadequate electrical capacity, technological lag, and (until 1937) insufficient supplies of high-grade ore forced primary Soviet reliance upon imports of ferro-chrome until 1934, and again during World War II. Even in 1947, while low chromium steels were numerous, only a few medium and high-chromium steels were in actual production. In contrast, chromite consumption for refractory and chemical purposes has always been high. Soviet chromite reserves are abundant to cover Hypothetical Standard requirements for the entire Soviet sphere, and also to continue exports. Of the satellites, Rumanian, Bulgaria and Albania have chromite resources.

PRODUCTION, FOREIGN TRADE, AND CONSUMPTION OF CHROMITE, 1926 - 1937

In 1926, the Soviet Union produced 30,162 m.t. of chromite, of which about a third came from Sarany and the rest from other deposits in the Urals. Although ferrochrome was neither produced nor imported, the consumption of refractory and chemical chromite alone totaled about 10,000 m.t. approaching Hypothetical Standard demand (12,400 m.t.). The bulk of the production in 1926, as in 1925, accumulated in stockpiles, which were gradually dispersed through the exports that began in 1927 (Table I). In fact, over 30 per cent of all Soviet chromite production between 1924 and 1935 was exported; in its peak export year, 1932, the Soviet Union was the world's largest chromite exporter. Yet, as previously mentioned, it depended until 1935 primarily on imports of ferrochrome. Production of this ferroalloy was particularly difficult for the U.S.S.R. because it lacked enough high-grade chromite until the discovery of the Kempirsai deposit in 1937.

TABLE I

<u>Year</u>	<u>Production</u>	<u>Exports</u>
1925	30,111	--
1926	30,362	--
1927	19,282	2,330
1928	25,500	30,100
1929	52,900	53,700
1930	82,000	15,050
1931	87,000	23,800
1932	62,100	41,600
1933	112,400	41,100
1934	131,100	36,500
1935	184,400	11,500

Foreign trade in chromite and ferrochrome ceased in 1935. Soviet chromite production in 1936 totaled 221,500 m.t., according to the State Planning Commission; of this total, about 180,000 m.t. came from Sarany and was utilized solely for refractory and chemical purposes (145,000 and 35,000 m.t., respectively). Chromite concentrate suitable for ferrochrome did not exceed 30-40,000 m.t. These data may also be used for 1937: although actual production in that year is unknown, the output plan 225,000 m.t. - merely continued 1936 conditions.

The pattern of Soviet chromite consumption in this period manifested several interesting features. Total consumption (221,000-225,000 m.t.) equaled Hypothetical Standard demand, but this can be attributed entirely to very extensive use of chromite refractories. Since chromite refractories have high fusion temperatures, this practice enabled the Soviets to run their blast and open-hearth furnaces hotter and longer than is customary in the United States. By American standards, 40 per cent of chromite consumption goes to refractories; by Soviet practice of the mid-1930's, 65 per cent went. Chromite consumption by the chemical industries took a normal proportion (16 per cent), but consumption for ferrochrome was both relatively

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and absolutely low.

CHROMITE TRENDS AND INDICATIONS, 1937 - 1947. By 1938, the Kempirsai deposit had been surveyed in part, and was known to have large reserves of first-class chromite. The regional pattern of production changed accordingly, so that Kempirsai was producing nearly 60 per cent of Soviet chromite in 1942, and Sarany, 39 per cent. Unfortunately, the total quantity produced cannot be established; [REDACTED]

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[REDACTED] In any case, the wartime output was substantial. It permitted the substitution of chrome steel for nickel steel in armor-piercing projectiles, which saved 7,000 m.t. of nickel in two-and-a-half years of war. [REDACTED]

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At the present time, the Soviet Union is clearly making great use of chromite refractories, and is experimenting with chrome-magnesite mixes. The specifications of 1947 called for the addition of 20 to 50 per cent of magnesite to chromite of 30-35 per cent Cr<sub>2</sub>O<sub>3</sub> content for best results. Such mixed refractories combine high fusion points (1820<sup>0</sup>- 1950<sup>0</sup>C) with resistance to deformation under pressure. However, as late as 1951, this new refractory was so scarce that only one open-hearth furnace at the Stalino steel mill could be lined with it.

Developments in regard to chrome alloys are revealing. During World War II, moderate imports of ferrochrome (3,848,000 pounds in 1942) were needed despite the abundance of chromite in the U.S.S.R.

SATELLITE CHROMITE SUPPLIES. Bulgaria has been a minor producer of chromite, with an output of 2,350 m.t. in 1937 and 7,000 m.t. in 1943. Albania's output appears to be even smaller, about 5,000 m.t. in 1942. Thus, the satellites are currently dependent upon Soviet chromite. However, Rumania is said to have undeveloped chromite resources of fair magnitude: 2 to 10 million m.t. with contents of 30-50 per cent Cr2O3.

CHROMITE RESERVES AND DEPOSITS. As of January 1, 1936, Soviet chromite ore reserves totaled 15,544,000 m.t. of which but 4,932,000 were measured. Reserves of high-grade ore (over 45 per cent Cr2O3) were very small. The discovery of the Kempirsai deposit ended this situation, although the full significance of the find was not realized immediately. In 1939, Kempirsai reserves were assessed, according to the State Planning Commission at about 170,000 m.t. of measured and 570,000 m.t. of total reserves. Further exploration showed, however, that this was an enormous deposit; Betekhtin stated that it was the largest in the world, definitely exceeding Sarany (with 14,101,000 m.t. of reserves). In all it appears safe to assume that Soviet chromite reserves aggregate fully 25 to 30 million m.t., an amount comfortably exceeding Hypothetical Standard requirements to 1970 for the entire Soviet sphere (14.6 million m.t.)

The Kempirsai deposit, in northern Kazakhstan (Turkestan Economic Region), consists of over 70 ore bodies 10 to 150 meters long and 0.5 to 10 meters thick; in all, the deposit covers an area of 1000 km. The Southeastern group, which consists primarily of serpentized dunites, is the richest. In contrast, the Northern group, associated mainly with peridotites, has ore high in Al2O3, with up to 20 per cent of FeO, and is usable only for refractory purposes. The other four significant deposits - Sarany, Klyuchevskaya, Khabarnyi, and Gora Verblyuzhaya - are all found in the Urals.

Sarany comprises five ore bodies, but the overwhelming part of its reserves is comprised in the principal mine. This contained 13,-300,000 m.t. of ore to a depth of 228 meters, as of January 1, 1933. Sarany chromite is of low quality, with 33.2-42.6 per cent of Cr2O3 (in 1936, 500,000 tons of ore had a Cr2O3 content of 40 per cent) 14.5-23.1 per cent of Al2O3, 14.3-22.0 per cent of FeO, 13.3-16.8 per cent of MgO, 0-3.80 per cent of CaO, and 2.3-9.0 per cent of SiO2. Attempts to concentrate the ores met with little success in the early 1930's; a concentrate having 42.5 per cent of Cr2O3 could be achieved only with losses of 80.5 per cent. In 1936, the annual capacity of the mine was being expanded to 200,000 m.t. of usable ore and concentrate.

Klyuchevskaya is the third largest chromite deposit in the U.S.S.R. Although the ores are lean, they concentrate satisfactorily; in the concentrate, Cr2O3 content increases from 15 to 56 per cent; SiO2 content drops from 20 to 1.78 per cent; 87 per cent recovery has been claimed. In 1936, a plant with a capacity of 50,000 m.t. of ore and 10,000 m.t. of concentrate was in operation here. The total reserves at Klyuchevskaya in 1936 were 655,000 m.t. of ore sufficient to yield 186,1000 m.t. of concentrate, according to Vakhromeyev's estimate.

Khabarnyi in the southern Urals is closely comparable to Klyuchevskaya, although smaller, with total reserves of 396,000 metric tons of ore (January 1, 1936). A concentration plant with a capacity of 10-15,000 metric tons of concentrate was being completed here in 1936.

Gora Verblyushaya is a small deposit formerly important as a producer. On January 1, 1933, its total reserves of massive ores with 40-45 per cent Cr2O3 content were 145,000 metric tons; of disseminated ores with 32-40 per cent Cr2O3 content, 61,000 metric tons. It is not certain whether this deposit has been exhausted.

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CHEMICAL COMPOSITION - RUSSIAN CHROMITE

<u>Ural Region</u>	<u>Cr2O3</u>	<u>Al2O3</u>	<u>FeO</u>	<u>MgO</u>	<u>SiO2</u>	<u>Cr/Fe</u>
I	36.34	17.12	15.30	18.31	6.20	2.09/1
II	42.65	14.41	14.52	16.26	8.12	2.58/1
III	35.75	17.31	18.34	16.54	5.43	1.72/1
IV	50.52	7.55	15.63	16.71	6.70	2.85/1
Average:	41.31	14.09	15.94	16.95	6.61	
<u>Kasachstan</u>						
I	54.76	9.64	12.37	16.28	4.52	3.89/1
II	58.16	9.19	12.27	16.10	2.30	4.17/1
III	42.08	6.76	10.15	19.27	10.82	3.65/1
IV	60.91	8.28	14.67	11.51	2.15	3.65/1
Average	53.97	8.46	12.36	15.79	4.84	

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RUSSIAN PRODUCTION OF CHROMITE (Estimated)  
Metric Tons

<u>1943-1947</u>	<u>1948</u>	<u>1949</u>	<u>1950</u>	<u>1951</u>	<u>1952</u>	<u>1953</u>
345,000	600,000	350,000	500,000	600,000	600,000	600,000

Output from U.S.S.R. in Asia included with U.S.S.R. in Europe

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<u>Gross Weight (Short Tons)</u>	<u>Average Analysis</u>		
	<u>Cr2O3</u>	<u>Fe</u>	<u>Cr-Fe</u>
158,118	51.87	10.45	3.40

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